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(54) **Display means**

(57) Display means comprises repeated displays provided side by side on a tunnel wall with stroboscopic lighting so operated that the displays appear stationary to passengers in a vehicle travelling through the tunnel. A control computer (1) controls a generator (2) to issue a square waveform, the positive and negative parts of which are fed to power pulse generators (3_1, 3_2). Presence detectors (4) sense the presence of a vehicle on a track and control two sets of strobe lights (7_1, 7_2) shining respectively onto the repeated displays on the tunnel wall and towards the vehicle. Speed measurement devices (8) using lights (6) and photocells (5) in pairs detect the vehicle speed and provide feedback to the control computer to set the frequency of the lights (7_1, 7_2).

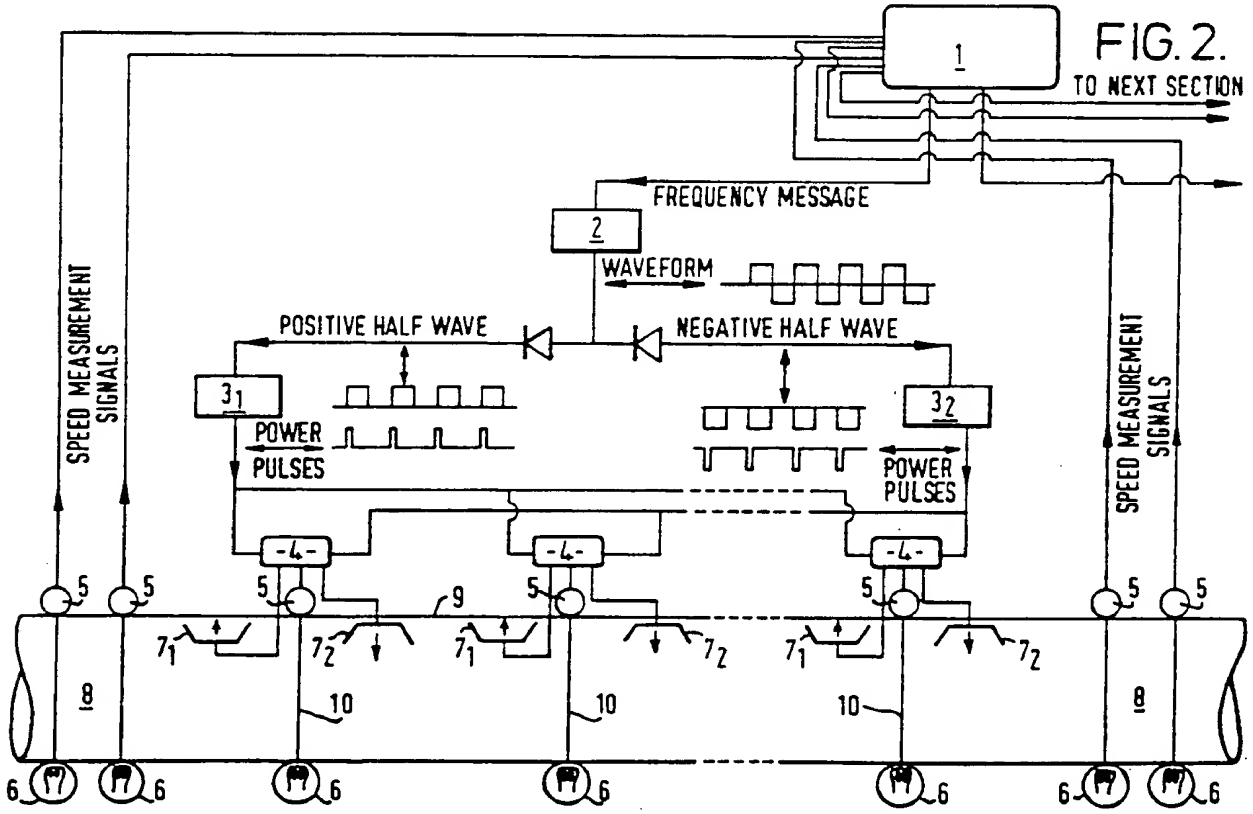

FIG. 2.

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.
The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1990.

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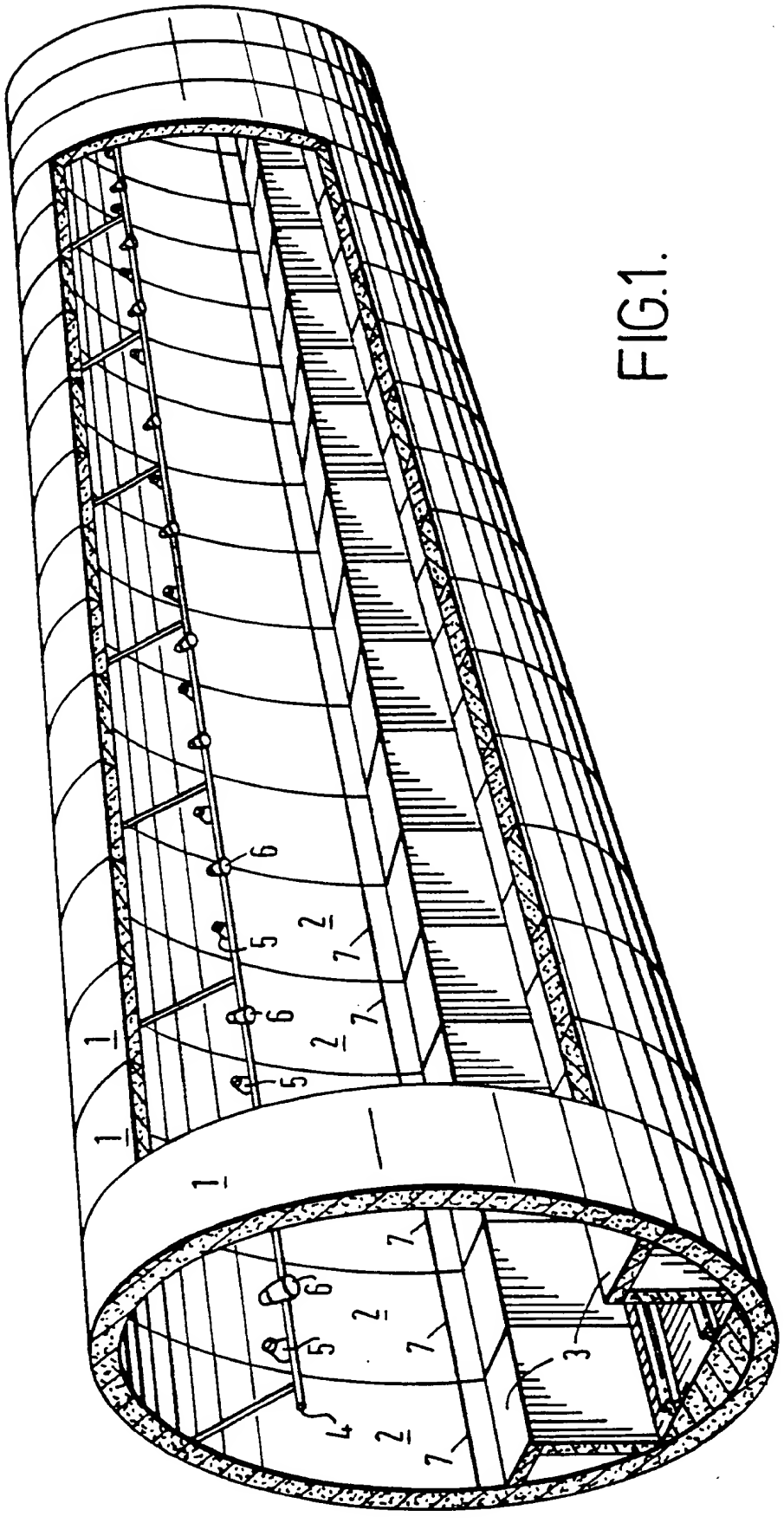
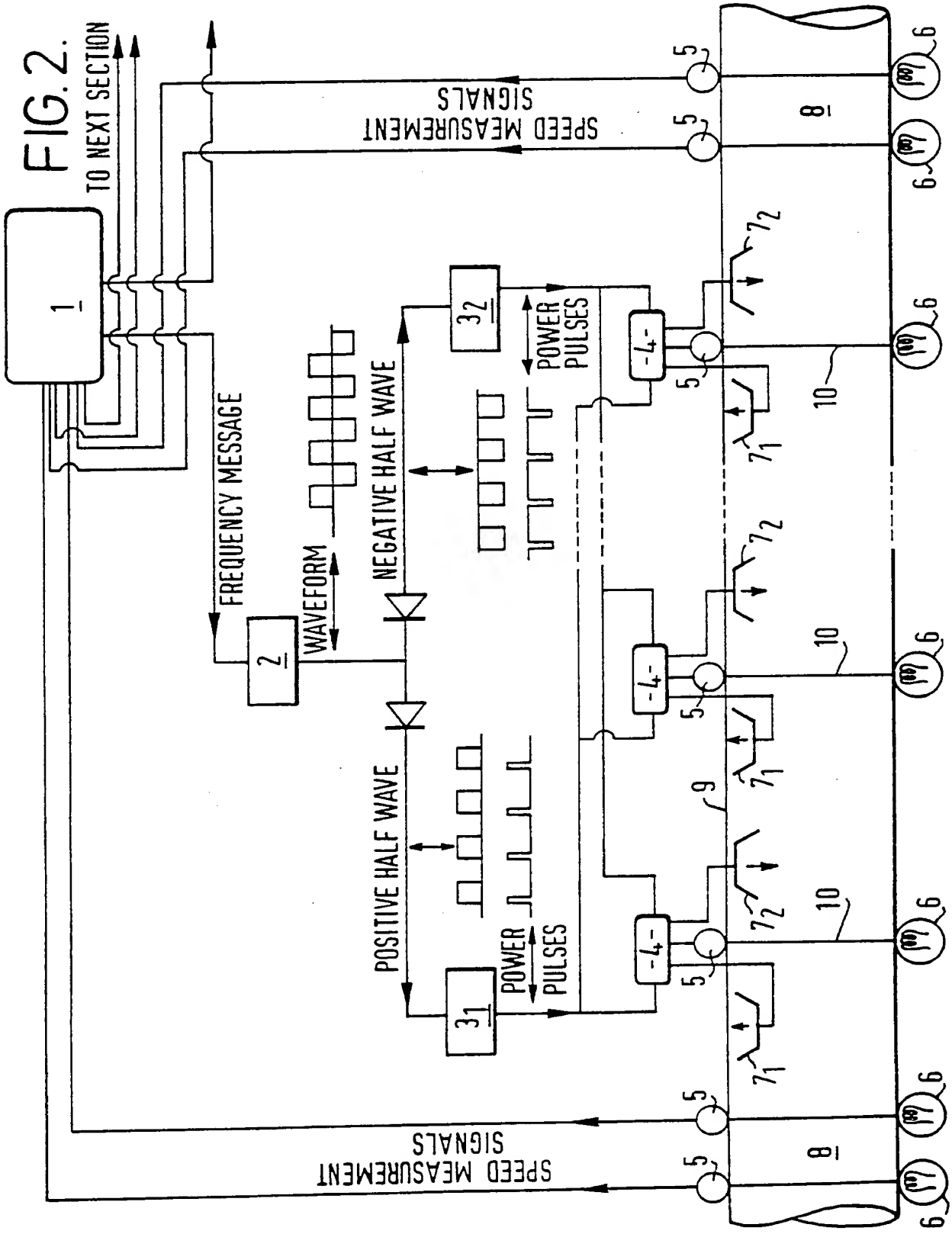


FIG.1.

FIG. 2.


TO NEXT SECTION
1
FREQUENCY MESSAGE
2
WAVEFORM
NEGATIVE HALF WAVE
POSITIVE HALF WAVE
3 2
3 1
POWER PULSES
POWER PULSES
SPEED MEASUREMENT SIGNALS
SPEED MEASUREMENT SIGNALS
4
5
6
7 1
7 2
8
9
10

DISPLAY MEANS

The invention relates to display means.

It is a commonly observed fact that the closer an object is to a railway track, the harder it is for a passenger on a fast moving train travelling on the track clearly to see the object. Thus, although a cow in a neighbouring field may be clearly visible, it is almost impossible to read the name of a station as it flashes by. This fact prevents the walls of railway tunnels from being used to display information, such as advertising, to train passengers at a time when they would be particularly receptive.

According to the invention there is provided display means comprising a succession of identical or similar displays placed side-by-side alongside a track on which a vehicle is to travel and stroboscopic lighting means to illuminate the displays and operable at a frequency such that when viewed from a vehicle moving along the track the displays appear to be stationary or slow moving and thus can be observed by persons carried in the vehicle.

The displays may for example be provided on the walls of a tunnel in which the track is provided for a train to run on, thereby to give train passengers something to see from the windows, particularly whilst travelling through long tunnels such as that under the Channel between England and France.

Preferably the frequency of the stroboscopic flashes is governed by the speed of the train and arranged so that the distance travelled by the train between flashes is equal to the width of the displays. The effect is to "freeze" the motion of the displays relative to the train, allowing passengers to view them without difficulty. Passengers nearest to the window would probably be able to see more than one image of the panel at a time but this should not disturb them, as they would tend to look at the nearest one.

An apparently stationary notice or advertisement can thus be presented to the view of the train passenger. The techniques of the motion picture industry can however be used to create animated displays if so desired. Artificial scenery can be created by the use of wall panels on which, for example, a scenery of green fields and hills or of blue sea and ships has been applied. If the panels bear identical

scenes and if the horizon is at the same height on either side of the panel, then the joins between the panels will not be obvious. The viewer might see more than one panel at a time but, if they were correctly designed, the effect would be of a continuous landscape.

By slightly altering the frequency of the flashes relative to the speed of the train, it is possible to cause the scene displayed to move slowly past the window, although the scene itself would not change.

A considerable refinement of the artificial land/sea-scape can be achieved by the use of simple animation, so that the scenery changes with time. The effect can thus be created of the train moving slowly through attractive scenery rather than very fast through a dark tunnel. Into this setting, it is possible to insert advertisements, in a natural way, as part of the passing scene. Animation would allow the advertisement to come into view on a "hoarding" standing in a "field" beside the track. It would be visible for long enough to be read and would then be passed by. Advertisements could, of course, also contain animated figures.

The artificial scenery can be provided by good quality graphics of a semi-permanent nature, whilst the advertisements can be printed paper posters, pasted to panels in the advertising spaces. These can be changed at intervals for relatively low cost. The materials used should be fire resistant.

The Channel tunnel between England and France will be about 50km long. There will be 2 train tunnels, one for each direction, and walls will be about 1.80 metres from the train windows on each side, due to the presence of a continuous platform for use in emergencies. The journey will take between 20 and 30 minutes and displays could be different on one side of the train from the other. Four lengths of tunnel wall with a total viewing time of between 80 and 120 minutes would thus be available to the advertiser.

Given the captive nature of the audience, publicity displayed in this way should be very effective and command a high price. Furthermore, the artificial scenery should help to prevent the claustrophobia which some passengers might otherwise experience.

Preferably the display means includes:-

1. Means for measuring the speed of a train at a plurality of positions in the tunnel;

2. Means for determining the appropriate frequency for triggering the stroboscopic lights;
3. Means for producing triggering pulses at this frequency.
4. The stroboscopic lights; and
5. Suitable display panels.

One way of providing these is as follows:-

1. Speed measuring device

This may comprise a pair of parallel light beams, shining across the tunnel onto photo-cells, and separated from each other by a few metres. Pairs of light beams can be situated at one kilometre intervals throughout the length of the tunnel so that any changes in the train's speed could be quickly detected.

The speed is obtained by measuring the time taken for the train to travel between the light beams in each pair. The instant at which the leading edge of the train crosses a light beam is detected by the associated photo-cell and a signal is sent to a small computer or micro-processor. The time difference between the receipt of the two signals is measured with high precision and an accurate value obtained for the speed of the train.

The speed, in metres per second, is obtained from the ratio of the separation of the two beams, in metres, to the time difference, in seconds.

2. Determination of the appropriate stroboscopic frequency

The same computing device also calculates the required frequency as the ratio of the speed of the train, in metres per second, to the width of the display panels, in metres. All panels preferably have the same width and are contiguous.

If it is desired to achieve the effect of motion, without animation, a slightly lower frequency is needed than that calculated by the above ratio and can be obtained by suitably programming the computer.

3. Generation of the triggering pulses

The value of the desired frequency is sent as a command to a separate unit, which generates the required triggering pulses for the one kilometre section that the train is about to enter. The pulse generator can be micro-processor based and one is provided for each kilometre length of tunnel. As the front of the train passes a speed

measuring device, it effectively switches on the stroboscopic lighting in the kilometre section it is entering, and as the tail of the train passes the same speed measuring point, it switches off the lighting in the kilometre section it is leaving.

The triggering pulse generator can be programmed to synthesise a square wave having the desired frequency. The amplitude of this wave is symmetrical about zero so that it has a positive and a negative half. The signal is amplified and the two halves are separated by diodes to give two series of pulses, each with the correct stroboscopic frequency. The pulses of one pulse series occur between the pulses of the other, that is they are 180° out of phase. This allows two sets of lights to be flashed at the same frequency but with the flashes of one set occurring between the flashes of the other.

This makes it possible to double the flicker frequency perceived by the viewer, without affecting the stroboscopic frequency. A similar effect is obtained in cinematography whereby the projector holds each frame still for a determined time, during which the shutter is opened and closed twice. The light received by the viewer thus fluctuates at twice the frequency needed for animation and is actually perceived as a steady, non-flickering light.

In this system, the stroboscopic flashes directed at the wall displays can be triggered by one of the pulse trains, whilst the other activates lights directed towards the viewer and away from the wall. These lights can be adjusted to give an equally intense illumination, at the position of the viewer, as the light reflected from the wall displays. The viewer thus perceives light fluctuating at twice the stroboscopic frequency, which means in effect without flicker, provided the train is travelling sufficiently quickly.

Should the train have to slow down below its normal operating speed of between 100 and 130 km/h, the controlling computer can suspend the stroboscopic illumination if the flicker frequency falls below a set limit. This limit would be determined on medical advice, bearing in mind that certain low frequencies may induce fits in epileptic sufferers.

The pulse trains can be fed to lighting control units designed to supply power to the lamps for a set time on receipt of a triggering signal. For a sharp image, the duration of the flashes should be short

relative to the time between flashes. Flashes would, therefore, have to be relatively bright.

Two other features are desirable to provide a good system. These are:-

- A means of ensuring that the stroboscopic display only works in the vicinity of a train and does not disturb the driver.
- A means of ensuring that the stroboscopic display is not needlessly activated by a goods train.

These features can be provided as follows.

Simple presence sensors are installed with each stroboscopic lamp so that it only works when a train is in front of it. A slight delay in this circuit ensures that the display begins after the driver's cab has passed by. The sensor may comprise a light beam shining across the tunnel onto a photocell. The presence of a train breaks the beam and allows the stroboscopic lights to function.

In order to prevent the display from being activated by a goods train, a transponder can be mounted at the front of each passenger train. Only on receipt of the correct signal from the passenger train is the display allowed.

In the event of the train stopping, the stroboscopic illumination is suspended and emergency lighting switched on in the immediate area thereby ensuring that the tunnel is dark except in the vicinity of a train and saving a considerable amount of electricity. Maintenance workers could switch on the emergency lights wherever they were by merely breaking a presence sensor beam.

If desired the illumination means for the displays can be provided on the train, with the frequency set by speed detection means provided on board the train. In such a case radar speed meters would be preferable for speed detection.

4. Stroboscopic lights

These should be capable of being switched rapidly on and off, coming quickly to full power and decaying equally quickly to zero. Suitable lamps are available for this application and are generally of the Xenon type. The number of lamps required depends on their power and position but might be one lamp for two panels. All lamps illuminating the panels are flashed together and all lamps used to double the flicker frequency are also flashed together.

Since a high speed train is about 220 metres long and would be travelling at about 130 km/h, each lamp would only have to flash for 6 seconds, whilst the train passes, so that a reasonable lifetime should be possible. Nevertheless, even with a regular maintenance schedule, lamps would occasionally fail and should be easily detected for replacement. This could be arranged by incorporating a photo-diode in the lamp housing to detect the light. In the event of failure, no light would be detected and a system of latched relays would cause a LED, also incorporated in the housing, to be illuminated. Maintenance technicians would thus have a simple indication of defective lights.

5. Display panels

The most critical feature of the display panels is their width, since this determines the stroboscopic frequency required for any particular speed of the train. The relationship by which the frequency is derived may be written as:-

$$F = S/W \text{ Hz}$$

where, F = stroboscopic frequency

S = speed of train in metres per second

W = width of panel in metres

The width of the tunnel lining sections is likely to be 125 cm and display panels can be provided of the same width. If, then, W is 1.25 m in the above equation, the frequency for various train speeds is:-

at 160km/h; F = 35.5 Hz and the eye is illuminated at 71 Hz.

at 100km/h; F = 22.2 Hz and the eye is illuminated at 44.4 Hz.

at 80km/h; F = 17.8 Hz and the eye is illuminated at 35.6 Hz.

at 60km/h; F = 13.3 Hz and the eye is illuminated at 26.6 Hz.

Clearly, the speed range 100 - 160 km/h would give flicker free display and 80 - 100 km/h would probably be acceptable. Below 80 km/h, however, the display would start to flicker unpleasantly and would have to be suspended.

If the speed of passenger trains is expected to drop frequently below 80 km/h, it is possible to increase the flicker frequency by arranging for two flashes to be aimed towards the viewer for every one flash aimed at the display. The animation would then appear somewhat jerky but without flicker.

Narrower displays would increase the stroboscopic frequency so that slower train speeds could still be acceptable. Moreover, by suitable programming of the computer, it would be possible to use a different width of panel on particular sections if needed. A display 1.25 m wide viewed from a distance of 2 m is equivalent to one 6 m wide, viewed from a distance of 10 m. The displays would not, therefore, be greatly restricted in the amount of information they could contain.

The vertical dimension of the panels is of little significance.

The graphics used for the display may be hand-drawn, computer generated or photographic. It is envisaged, in this version of the system, that illumination would be from the front and that the displays should, therefore, be opaque. It would however be possible to arrange backlighting for transparent displays.

In the case of front lighting, it would be preferable to use matt surfaces to avoid shine. With back lighting this would not matter and displays could be actual photographic transparencies.

Photographic transparencies could be produced using a standard motion picture camera working on its side.

Whatever the system used to generate the displays, they would all desirably have a transverse reference line, preferably at the top or the bottom, to ensure good vertical alignment on the tunnel wall. Horizontal alignment would be ensured by careful production of the individual displays.

The invention is diagrammatically illustrated by way of example in the accompanying drawings, in which:-

Figure 1 is a cutaway drawing of a tunnel showing the positioning of display panels and stroboscopic lights of display means according to the invention; and

Figure 2 is a schematic representation of a control system of display means according to the invention.

Referring to the drawings and firstly to Figure 1, tunnel sections 1 each have a display panel 2 on the inner face thereof, the display panels 2 being located side by side in contiguous array above a platform 3. At an upper location a strobe light rail 4 mounts strobe lights 5 shining towards the display panels 2 and strobe lights 6 shining away from the panels 2. A transverse alignment line 7 is

provided adjacent the lower edge of each display panel 2.

Referring to Figure 2, a control computer 1 issues a frequency message to a waveform generator 2 which generates a square waveform, the positive half wave of which is fed to a first power pulse generator 3_1 and the negative half waveform of which is fed to a second power pulse generator 3_2. A plurality of presence detectors 4 have photocells 5 cooperating with light sources 6, the photocells 5 and light sources 6 being arranged on opposite sides of a track on which a train can run such that the light beam 10 from the light source falling on the photocell is interrupted when a train passes. Each detector 4 controls strobe lights 7_1 shining onto display panels mounted on the walls 9 alongside the track and strobe lights 7_2 shining away from the display panels towards the track. Speed measurement devices 8 include further photocells 5 cooperating with light sources 6 in pairs spaced apart longitudinally beside the track and connected back to the computer 1 which can therefore determine the speed of a train passing through the successive pairs. The computer can thus control illumination of the strobe lights 7_1, 7_2 in accordance with signals received indicating the presence of and speed of a passing train so that passengers in the train can view apparently stationary or near stationary displays on the walls of the tunnel.

CLAIMS

1. Display means comprising a succession of identical or similar displays placed side-by-side alongside a track on which a vehicle is to travel and stroboscopic lighting means to illuminate the displays and operable at a frequency such that when viewed from a vehicle moving along the track the displays appear to be stationary or slow moving and thus can be observed by persons carried in the vehicle.

2. Display means according to claim 1, in which the displays are provided on the walls of a tunnel in which the track is provided for a train to run on.

3. Display means according to claim 2, in which the frequency of the stroboscopic flashes is governed by the speed of the train and arranged so that the distance travelled by the train between flashes is equal to the width of the displays.

4. Display means according to any one of claims 1 to 3, including means for measuring the speed of a train at a plurality of positions in the tunnel;
means for determining the appropriate frequency for triggering the stroboscopic lights;
means for producing triggering pulses at this frequency; and
suitable display panels to be illuminated by the stroboscopic lighting means and forming the displays.

5. Display means according to claim 4, in which the means for measuring the speed comprise a pair of parallel light beams, shining across the tunnel onto photo-cells, and separated from each other by a distance and means to measure the time taken for a train to travel between the light beams of the pair.

6. Display means according to claim 4 or claim 5, in which the means for determining the appropriate stroboscopic frequency comprise a computing device to calculate the required frequency as the ratio of the speed of the train, in metres per second, to the width of display

panels of the displays, in metres, the panels having the same width and being contiguous.

7. Display means according to any one of claims 4 to 6, in which the means to produce triggering pulses is effective to send the value of the desired frequency as a command to a micro-processor based pulse generation unit which generates required triggering pulses for a track section that the train is about to enter.

8. Display means according to claim 7, in which the arrangement is such that, as the front of the train passes a speed measuring device, it effectively switches on the stroboscopic lighting in the track section it is entering, and as the tail of the train passes the same speed measuring point, it switches off the lighting in the track section it is leaving.

9. Display means according to claim 7 or claim 8, in which the triggering pulse generator can be programmed to synthesise a square wave signal having the desired frequency and an amplitude of wave symmetrical about zero so that it has a positive and a negative half.

10. Display means according to claim 9, in which the signal is amplified and the two halves are separated by diodes to give two series of pulses, each with the correct stroboscopic frequency, with the pulses of one pulse series occurring between the pulses of the other, that is to say 180^{o} out of phase.

11. Display means according to claim 10, in which two sets of lights are provided to be flashed at the same frequency but with the flashes of one set occurring between the flashes of the other.

12. Display means according to claim 11, in which stroboscopic flashes from one set of lights are directed at the wall displays and are triggered by one of the pulse trains and flashes from the other set of lights are directed towards the viewer and away from the wall and are triggered by the other of the pulse trains.

13. Display means according to any one of claims 4 to 12, including means to ensure that the stroboscopic display only works in the vicinity of a train and does not disturb the driver.

14. Display means according to any one of claims 4 to 13, including means to ensure that the stroboscopic display is not needlessly activated by a goods train.

15. Display means according to claim 13, including presence sensors installed with each stroboscopic lamp so that it only works when a train is in front thereof and delay means in this circuit to ensure that the display begins after the driver's cab has passed by.

16. Display means according to claim 14, including receiving means for a signal from a transponder mounted at the front of each passenger train and effective to energise the display means only on receipt of the correct signal from the passenger train.

17. Display means according to any one of claims 1 to 4, in which illumination means for the displays are provided on trains, with the frequency set by speed detection means provided on board the trains.

18. Display means according to any one of claims 4 to 17, in which the displays comprise display panels of uniform width, with a transverse reference line to ensure good vertical alignment on the tunnel wall.

19. Display means according to any one of the preceding claims, in which the displays are hand-drawn, computer generated or photographic with the displays opaque with illumination from the front or with the displays transparent and backlit.

20. Display means substantially as hereinbefore described and illustrated with reference to the accompanying drawings.